



DRAFT MEMORANDUM

To: EPA
Copy To: File 80021
From: J. Brunelle, J. Lambert
Subject: Olin groundwater extraction alternatives – feasibility
Date: 6/27/19

This technical memorandum (Memo) provides a conceptual-level evaluation of the feasibility of gaining access to locations to install monitoring and/or extraction wells in the heart of the assumed n-nitrosodimethylamine (NDMA) plume (see Figure 1) at the Olin Chemical Superfund Site (the Site), specifically within the Maple Meadow Brook Wetlands (MMBW).

1.0 TARGET AREAS

The targets for groundwater extraction are the two areas of the groundwater plume with NDMA concentrations above 11,000 ng/L. These plume areas emanate downgradient from the Main Street DAPL pool that was likely formed by DAPL flowing from the Containment Area and through the Jewel Drive (OPWD) DAPL pool. The target area for groundwater extraction is based on the following assumptions:

- NDMA concentrations in deep overburden has been used to estimate total plume dimensions because shallow overburden groundwater NDMA concentrations are generally lower and bedrock NDMA data is extremely limited.
- NDMA is used as an indicator because the areas with high NDMA values also have high concentrations of other contaminants that have been detected more than three orders of magnitude above their respective tapwater RSLs (cobalt, iron, manganese, and formaldehyde). See Attachment A for contour maps.

DAPL pool areas are derived from Wood's IAFS Figure 1-4-2 (Wood, 2019). The DAPL pool and downgradient plume areas may be revised based on the pending results of the 2019 site-wide groundwater sampling effort.

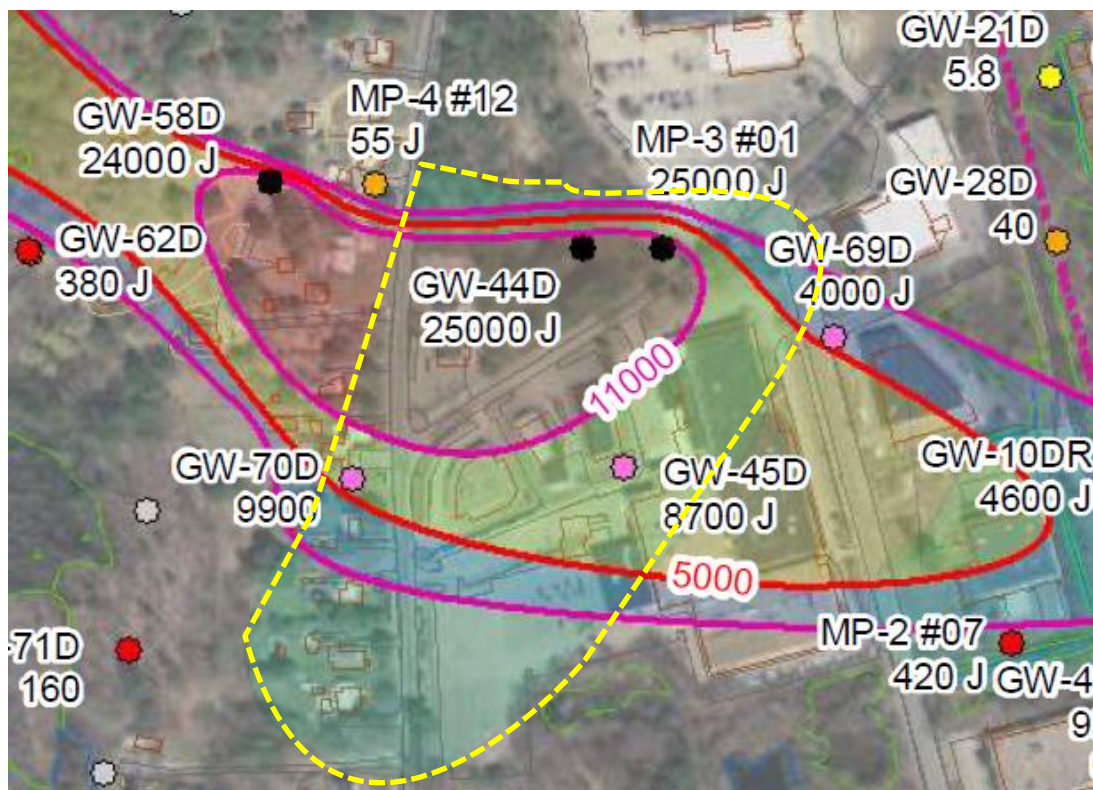
1.1 Main Street DAPL Pool – DAPL and Groundwater Hotspot Extraction

Approximately 13 to 18 million gallons of residual DAPL and overlying highly contaminated groundwater serve as a continuing source of contamination in and downgradient to the Main Street DAPL Pool area. Olin included DAPL extraction in the IAFS in the Main Street DAPL Pool to reduce concentrations of NDMA.

Groundwater above the DAPL pool may also be extracted to manage migration of contamination; however, groundwater extraction in this area will require a design that will minimize intrusion of DAPL into the overlying groundwater (that would add complexity to the treatment train) and minimize intrusion of groundwater into the DAPL below (that would add excess volume requiring special treatment and disposal).

Main Street DAPL Pool Accessibility

The Main Street DAPL pool area is expected to be accessible, as area businesses have large parking lots, the area is relatively flat, and EPA/Olin have obtained access agreements to properties in this area in the past. See sketch below:





Groundwater extraction wells within the DAPL pool should focus on the highest groundwater concentrations above DAPL. Therefore, groundwater extraction would be focused on the eastern portion of the DAPL pool and the area downgradient (to the northwest). See Figure 1 for the potential target area. DAPL extraction should be focused on the areas of deepest bedrock that are generally located in the center of the DAPL pool (Nobis, 2019).

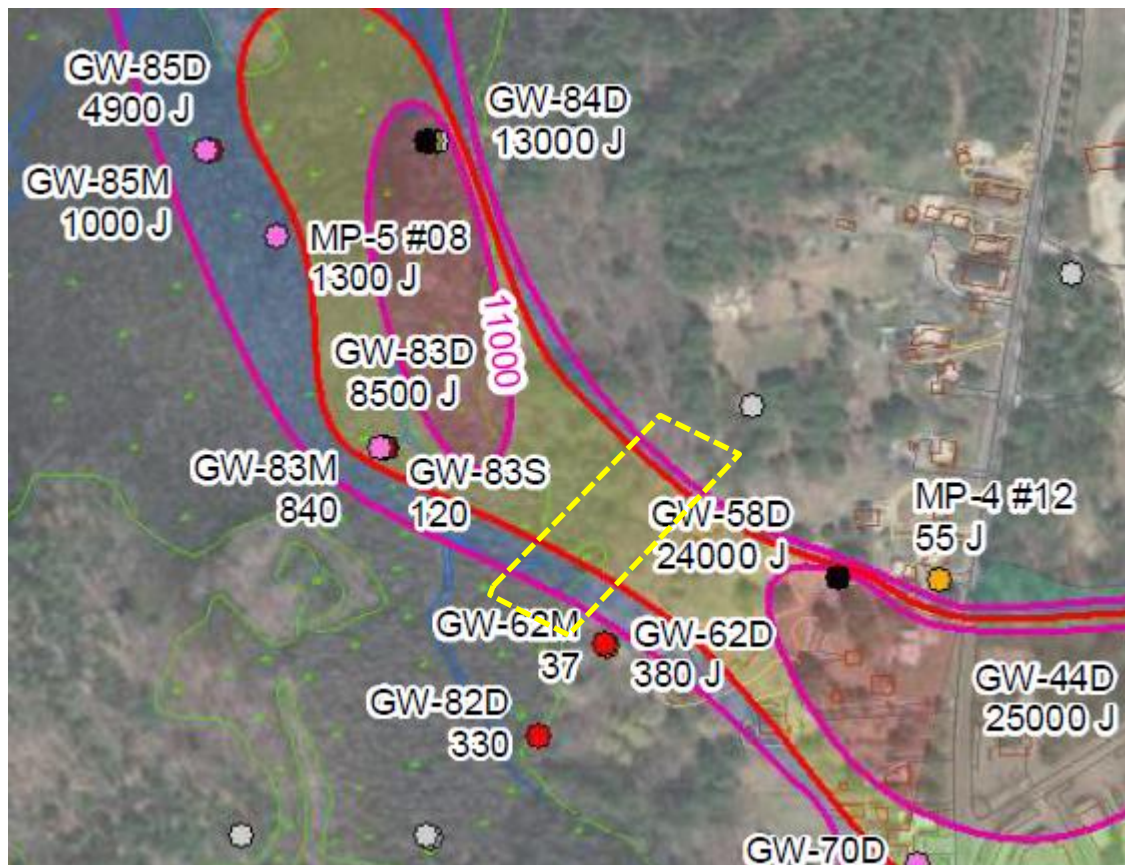
1.2 Main Street DAPL Pool – Downgradient Cutoff

As stated above, the Main Street DAPL Pool and overlying highly contaminated groundwater may serve as a continuing source of contamination to the MMBW. Nobis recommends installing groundwater extraction wells to manage plume migration by extracting contaminated water exiting the Main Street DAPL Pool, or a cross-section of the groundwater downgradient of the DAPL pool. See Figure 1.

Downgradient Cutoff Accessibility

The proposed area for a line of cutoff extraction wells is in a wooded area between the residences on the northwest side of Main Street and the southeastern edge of the MMBW. This line of potential target wells (see Figure 1) crosses several residential properties.

Tree clearing through residential properties would be required to create staging areas and roadways to access proposed drilling locations. While there may be physical access to install extraction wells and piping and/or treatment systems, legal access may prove to be difficult. See sketch below for the general area for downgradient plume cutoff wells.



1.3 Maple Meadow Brook Wetland

The hot spot downgradient of the Main Street DAPL pool is located within the MMBW. The wetland area is shown on Figure 1. Previously Olin installed monitoring wells in MMBW when the operational town water supply wells had dewatered the wetlands. Discontinued operation of the municipal wells allowed for groundwater levels to recover.

Nobis visited the Site on May 17, 2019, during expected high water conditions, to evaluate wetland conditions and collect depth measurements along the edge of the wetlands. Photos are included in Attachment B.

MMBW, as measured at the edge of the wetlands, was approximately 2 feet deep. The depth of water, as indicated by the tops of the existing vegetation, appeared to be similar throughout, except for several stream channels that flow through the wetland. Nobis measured the stream channel where it crosses under Main Street to be approximately 6 feet deep.



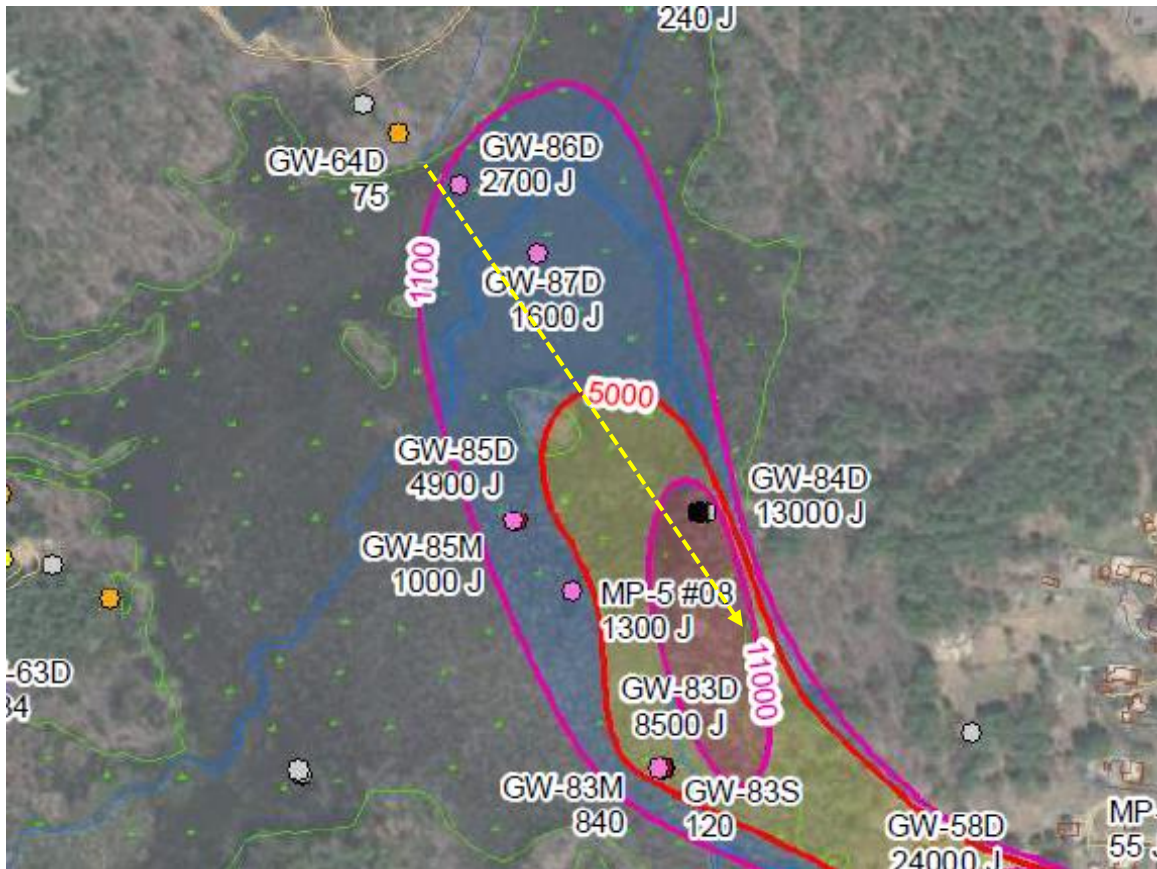
MMBW Accessibility

Nobis researched several alternatives to install temporary infrastructure to allow for drill rig access to saturated wetland areas. After the discussion of several alternatives, contractors (primarily utility contractors for large scale linework and forestry contractors) recommended installation of swamp mats for access to install monitoring wells, extraction wells, and other infrastructure. According to expert contractors, swamp mats are the most cost-effective alternative with the least amount of permanent wetland disturbance; however, Nobis did not perform an in-depth evaluation of other means and methods (we relied on the judgement of the contractors).

The depth of the water (expected to be 2-3 feet) does not prevent installation of swamp mats, as these can be stacked to up to 10 feet. Typical swamp mats (4 x 16 feet) would be used for most areas, but specialty mats (6 x 40 feet) can be used to bridge deeper stream channels.

Swamp mat deployment requires large laydown and staging areas to be most cost-effective. Nobis proposed a wetland traverse trending southeast from the Butter's Row Water Treatment Plant (WTP) into the MMBW hotspot area (approximately 1700 feet). Although the MMBW hotspot is closer to the southwest edge of MMBW, primary access from Town-owned land is preferred (vs access through residential properties to the southeast) because access is assumed to be more easily granted (town property vs. several residential parcels) and it assumed to be less impacting to the environment and neighbors because of reduced tree and wetland clearing, and minimal encroachment on private property.

Proposed well locations to address groundwater investigation are included in Figure 1. These locations are intended to take advantage of a single line of access (see sketch below) to minimize impacts to the wetland. The monitoring well locations may be later converted to extraction wells if additional work suggests that a plume cutoff line closer to Main Street is not enough or otherwise impractical for addressing the groundwater hot spots.



I.C. Reed & Sons, Inc. of Raymond, NH provided loose, order of magnitude costing for deployment of swamp mats in the above specified location. Estimated cost for the deployment, recovery, and rental of swamp mats, and limited site restoration ranges from \$1.5 million to \$2 million. This range accounts for adjustments of placed mats, installation of multiple levels of mats (up to 5 layers) to account for varying wetland depths, and other logistical challenges associated with mat placement in varying normal conditions.

2.0 LIMITATIONS

As stated above, this feasibility evaluation focuses primarily on traversing the wetland to install monitoring and extraction wells in key site areas. Olin should complete a full pre-design investigation to fully scope a groundwater alternative that would include:

- Specialty drillers.
- Additional locations for well placement and site assessment.
- Logistics and locations for treatment/recovery plants and associated piping runs, etc.



This accessibility study also assumes that:

- The Town will grant use of their property.
- Wetland permitting/access can be obtained.
- Actual well locations can be accessed by one line of swamp mats.

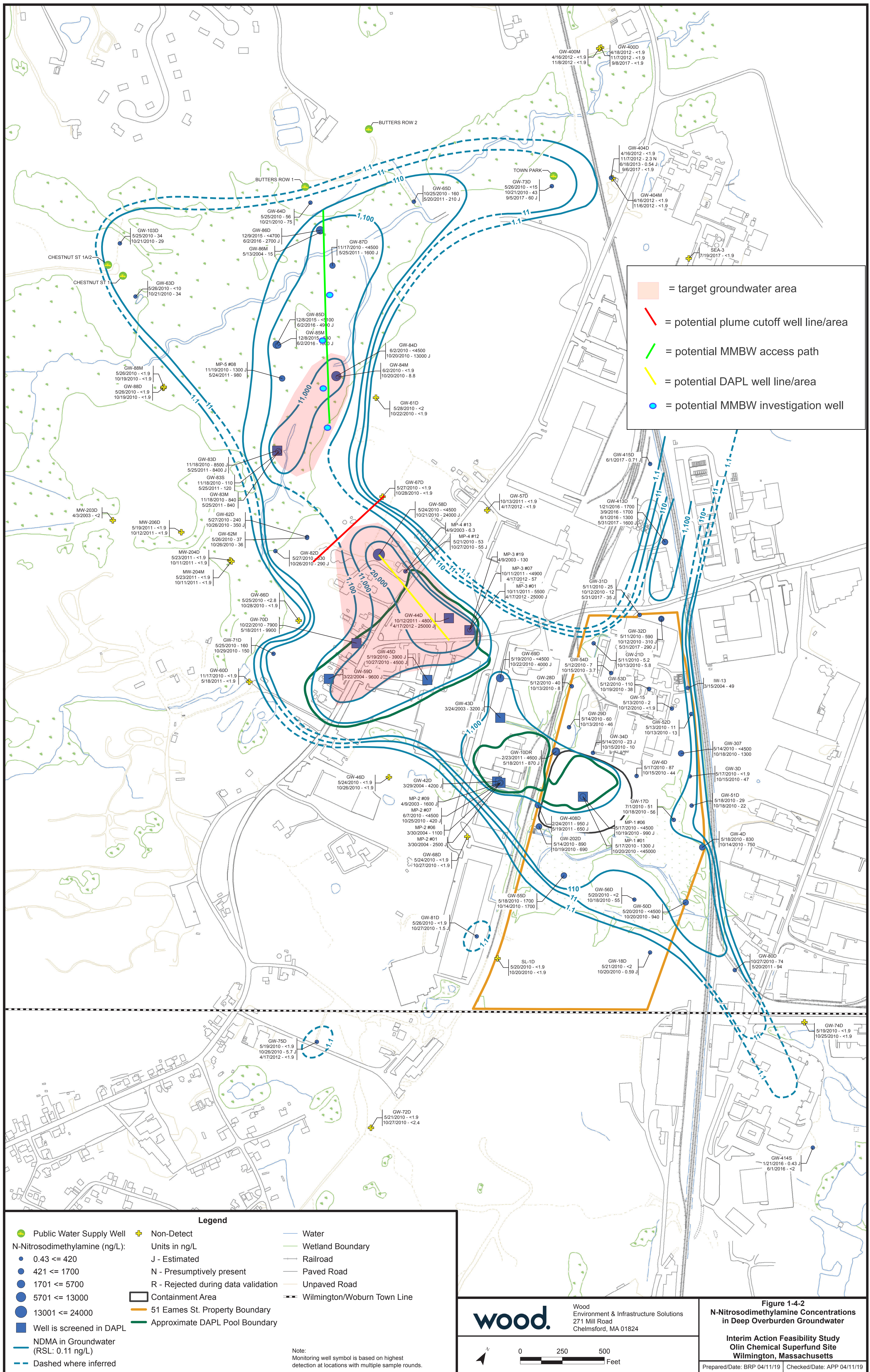
3.0 REFERENCES

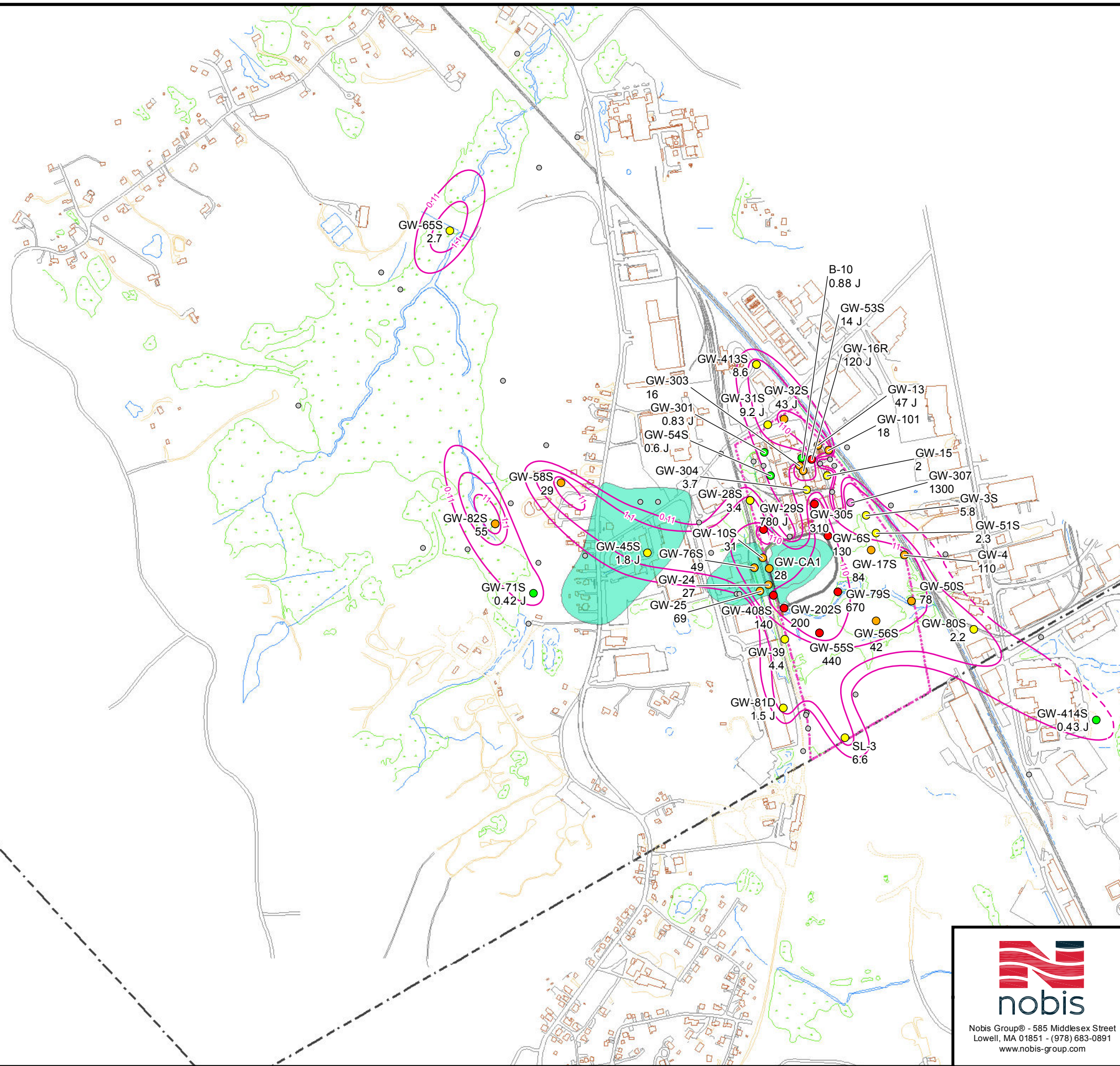
Nobis, 2019. Memorandum re: Olin Chemical Superfund Site – DAPL Extraction Alternatives. June 17.

Town of Wilmington, 2019. Wilmington Online GIS Map. Accessed May 20. <https://www.mapsonline.net/wilmingtonma/index.html>

Wood, 2019. Draft Interim Action Feasibility Study, Olin Chemical Superfund Site, Wilmington, Massachusetts. April.

Figure 1: Potential Groundwater Extraction Target Areas





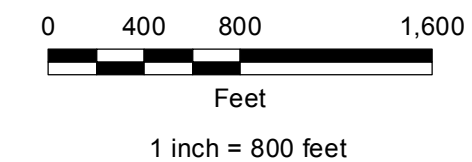
- Notes:**
1. Maximum result from 2010-2017 sampling events is labeled.
 2. All concentrations shown are in nanograms per liter (ng/L).
 3. Locations of site features depicted hereon are approximate and given for illustrative purposes only.


Legend

NDMA in Shallow Overburden

Tapwater RSL = 0.11 ng/L

- < Reporting Limit
- 0.11- 1.1
- 1.1 -11
- 11 - 110
- 110 - 1,100
- 1,100 - 11,000
- NDMA Isococentration Contour
- - - Inferred NDMA Contour
- DAPL Pools
- Paved Road
- Unpaved Road
- Rail
- - - Site Boundary
- Water Features
- Buildings
- Wetlands





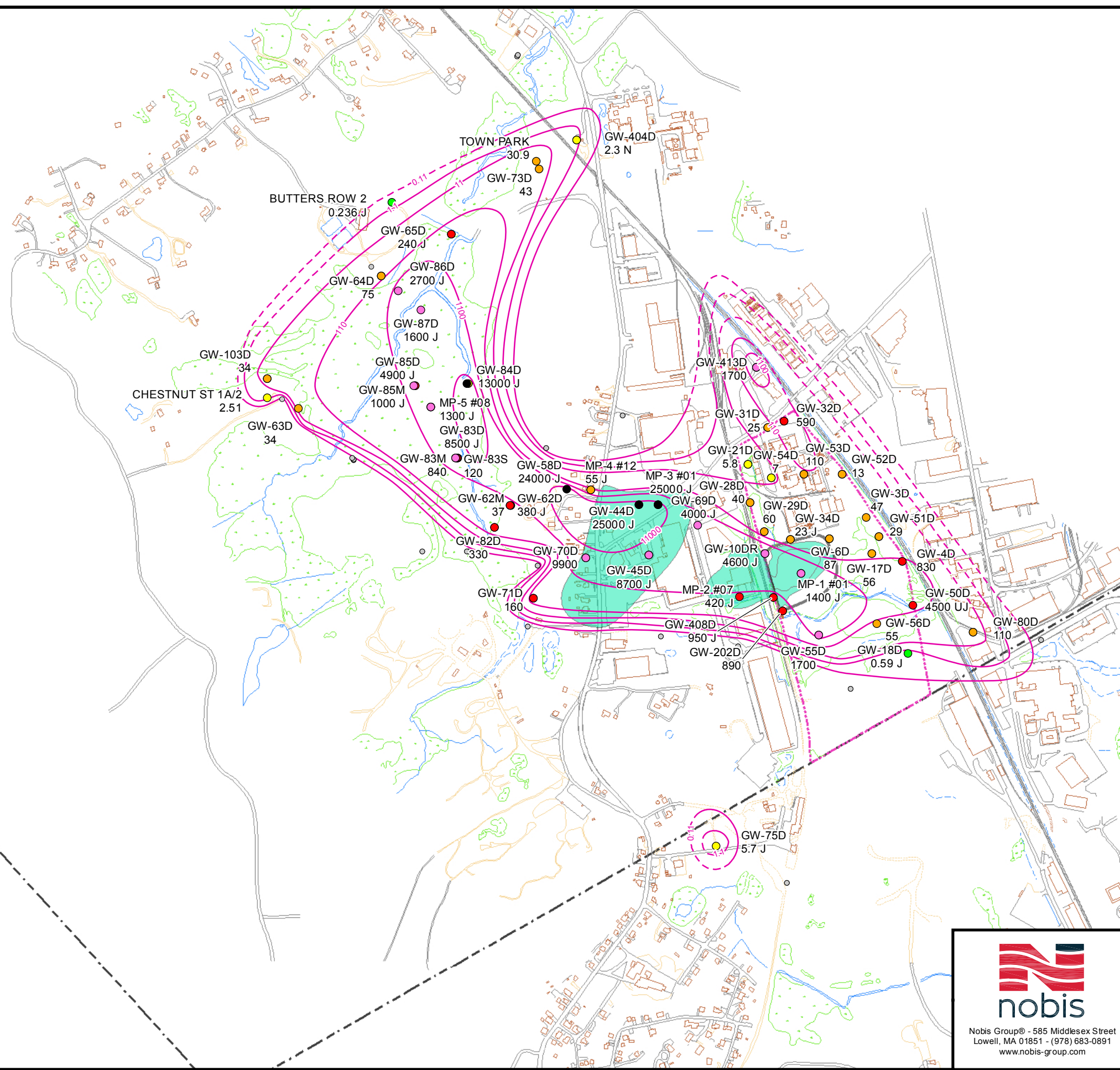
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FIGURE 6A

NDMA IN SHALLOW
OVERBURDEN GROUNDWATER
OLIN CHEMICAL SUPERFUND SITE
WILMINGTON, MASSASHUSETTS

PREPARED BY: JH	CHECKED BY: JL
PROJECT NO. 80021	DATE: NOVEMBER 2018

R:\80000 Task Orders\80021 Olin Chemical\Technical Data (TD)\GIS_Data\Maps_Figures\2018 Groundwater Contaminant Contour Maps\Figure 1 thru 9 Olin 2018 GW Contaminant Contours.mxd 5/22/2019 06:54 jharrington



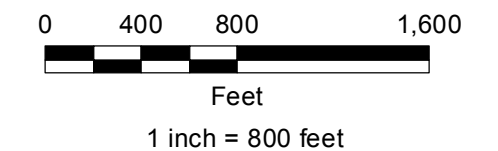
Notes:

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Legend

**NDMA in Deep Overburden
Tapwater RSL = 0.11 ng/L**

- < Reporting Limit
- 0.11 - 1.1
- 1.1 - 11
- 11 - 110
- 110 - 1,100
- 1,100 - 11,000
- 11,000 - 110,000
- NDMA Isococentration Contour
- - - Inferred NDMA Contour
- DAPL Pools
- Paved Road
- Unpaved Road
- Rail
- - - Site Boundary
- Water Features
- Buildings
- Wetlands



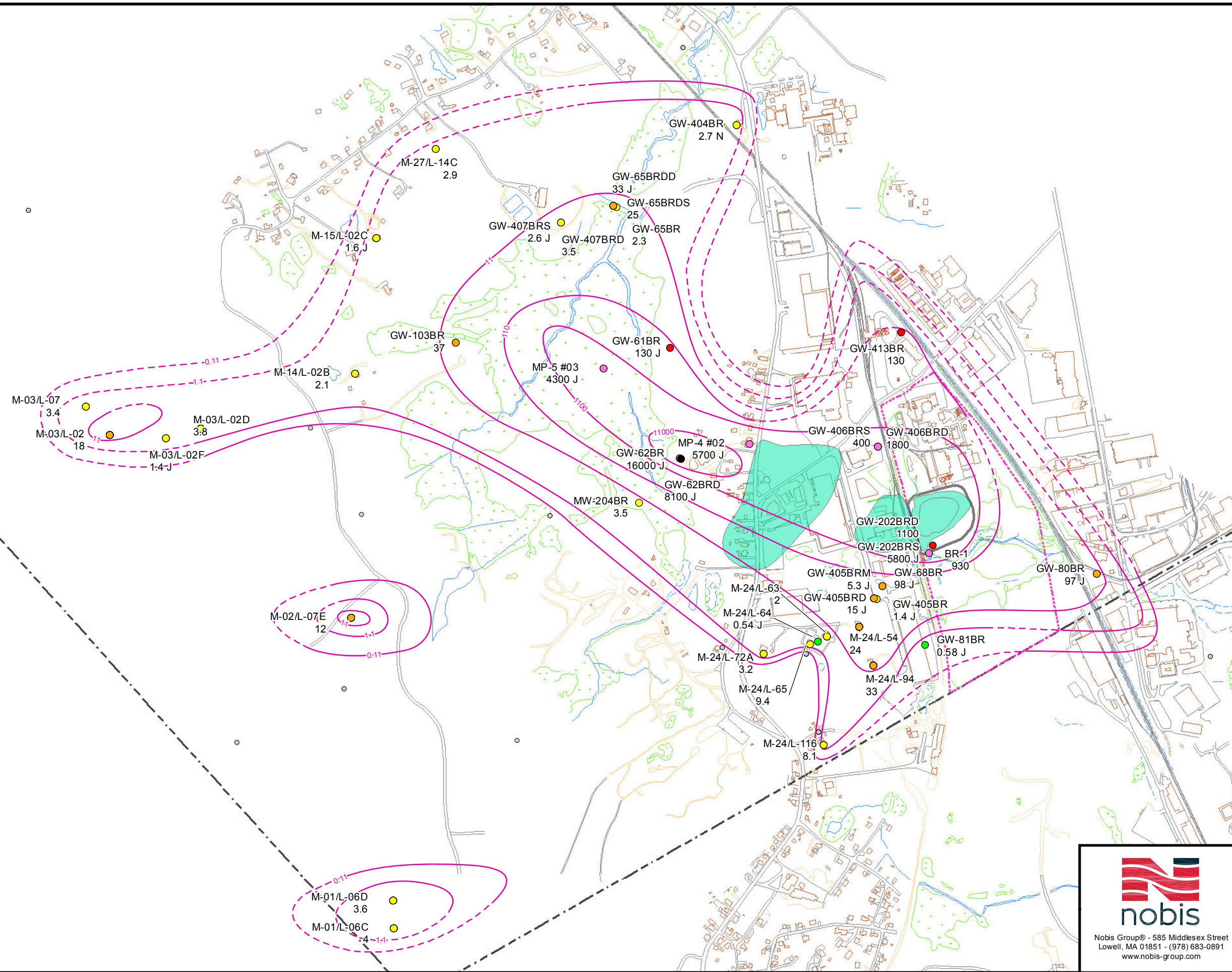

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FIGURE 6B

**NDMA IN DEEP
OVERBURDEN GROUNDWATER
OLIN CHEMICAL SUPERFUND SITE
WILMINGTON, MASSASHUSETTS**

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PROJECT NO. 80021	DATE: MAY 2019

R:\80000 Task Orders\80021 Olin Chemical\Technical Data (TD)\GIS_Data\Maps_Figures\2018 Groundwater\Contaminant Contour Maps\Figure 1 thru 9 Olin 2018 GW Contaminant Contours.mxd 11/19/2018 13:07 jharrington



Notes:

1. Maximum result from 2010-2017 sampling events is labeled.
2. All concentrations shown are in nanograms per liter (ng/L).
3. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

NDMA in Bedrock

Tapwater RSL = 0.11 ng/L

- < Reporting Limit
- 0.11 - 1.1
- 1.1 - 11
- 11 - 110
- 110 - 1,100
- 1,100 - 11,000
- 11,000 - 110,000

— NDMA Isococentration Contour

- - - Inferred NDMA Contour

■ DAPL Pools

— Paved Road

— Unpaved Road

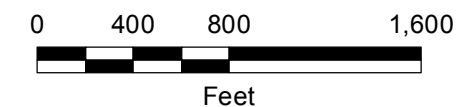
— Rail

- - - Site Boundary

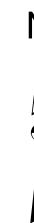
— Water Features

— Buildings

— Wetlands



1 inch = 800 feet



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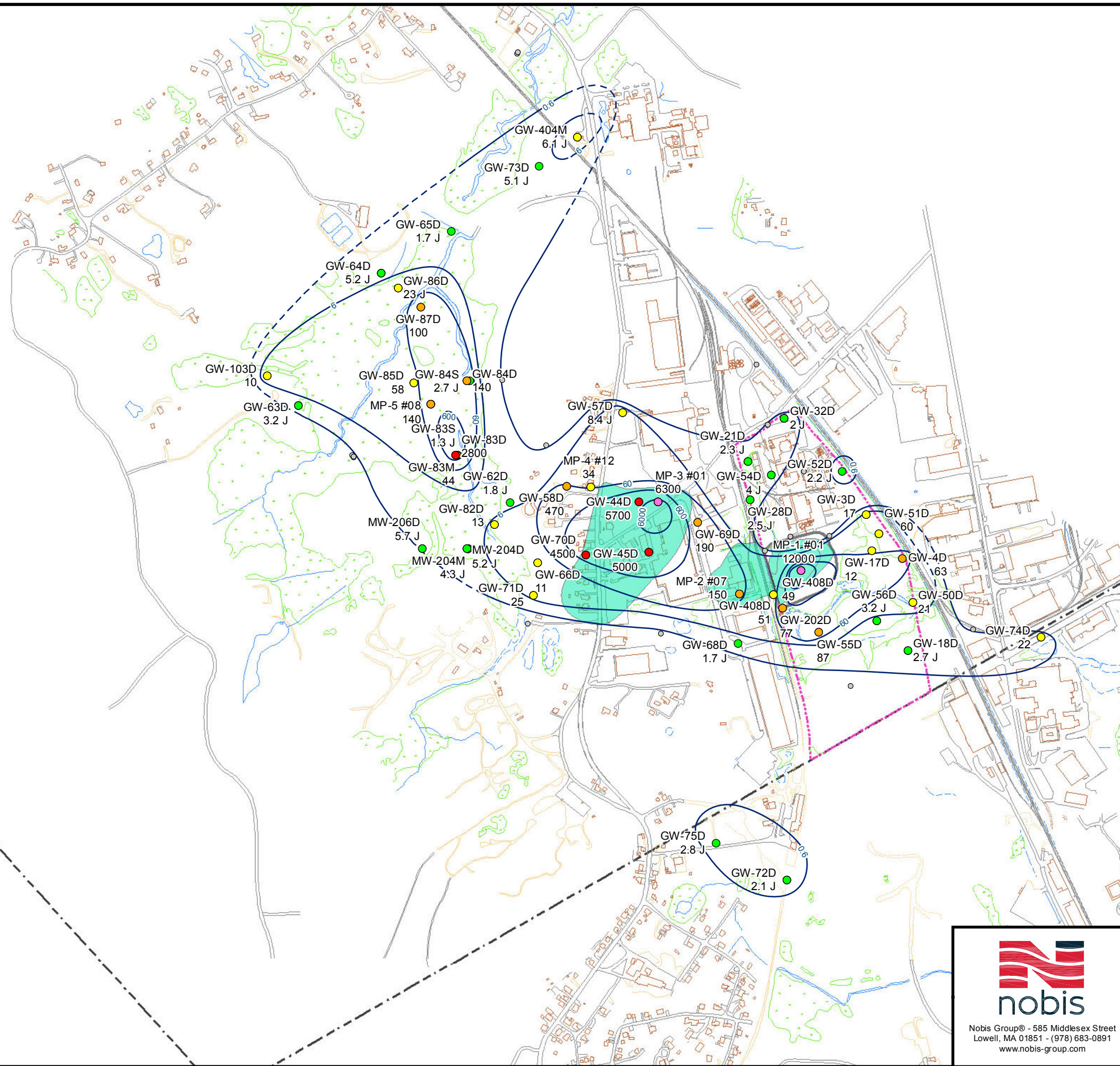
FIGURE 6C

**NDMA IN BEDROCK GROUNDWATER
OLIN CHEMICAL SUPERFUND SITE
WILMINGTON, MASSASHUSETTS**

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PROJECT NO. 80021

CHECKED BY: JL
DATE: NOVEMBER 2018

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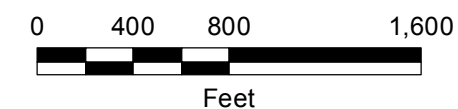
1. Maximum result from 2010-2017 sampling events is labeled.
2. All concentrations shown are in micrograms per liter (ug/L).
3. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

Cobalt in Deep Overburden

Tapwater RSL = 0.6 ug/L

- < Reporting Limit
- 0.6 - 6
- 6 - 60
- 60 - 600
- 600 - 6,000
- 6,000 - 60,000
- Cobalt Isococentration Contour
- - - Inferred Cobalt Contour
- DAPL Pools
- Paved Road
- Unpaved Road
- Rail
- - - Site Boundary
- Water Features
- Buildings
- Wetlands



1 inch = 800 feet

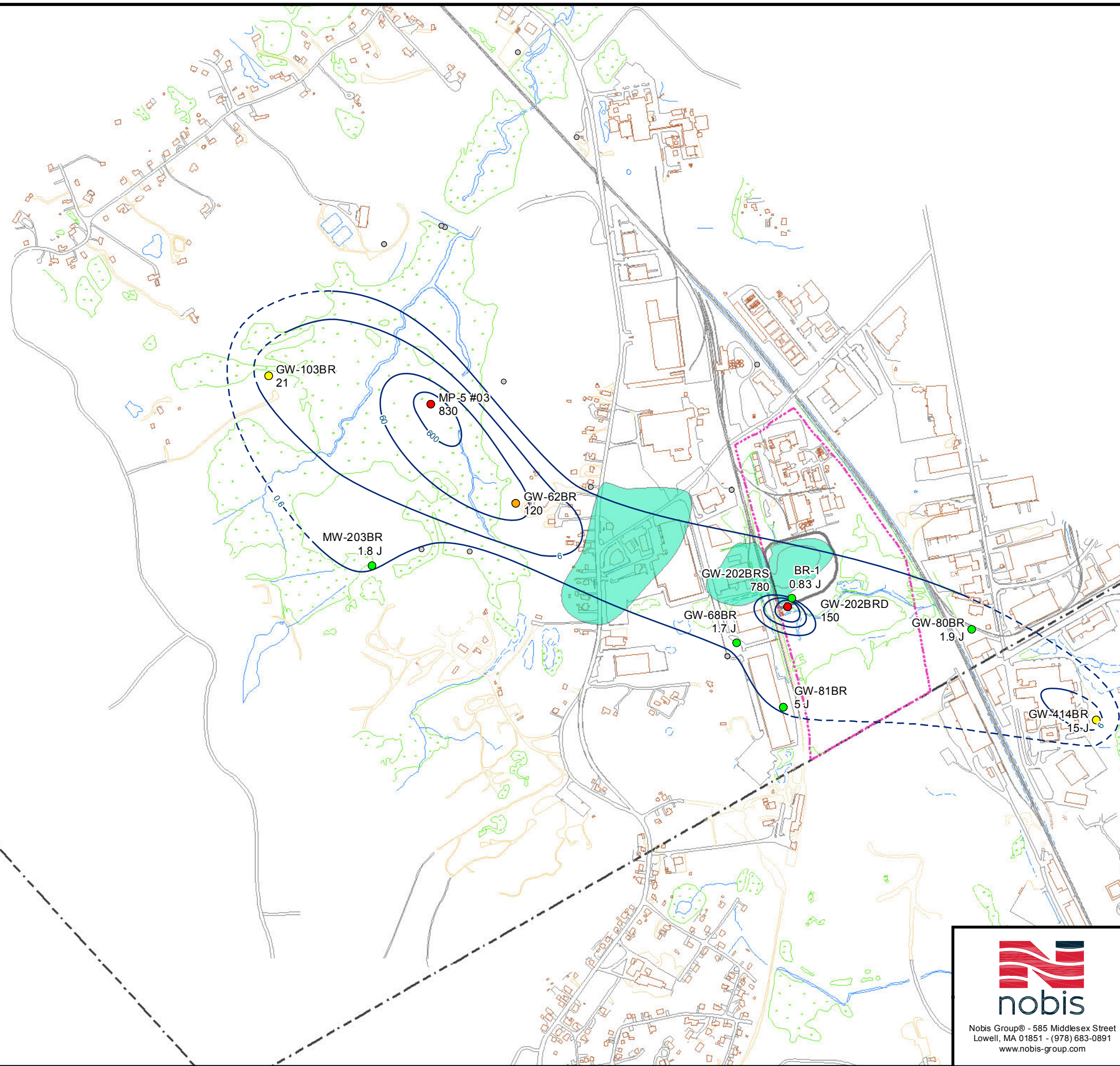


FIGURE 9B

**COBALT IN DEEP
OVERBURDEN GROUNDWATER
OLIN CHEMICAL SUPERFUND SITE
WILMINGTON, MASSASHUSETTS**

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PROJECT NO. 80021	DATE: NOVEMBER 2018

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Notes:

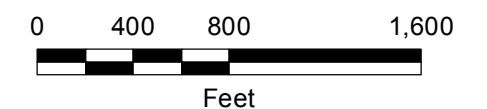
1. Maximum result from 2010-2017 sampling events is labeled.
2. All concentrations shown are in micrograms per liter (ug/L).
3. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

Cobalt in Bedrock

Tapwater RSL = 0.6 ug/L

- < Reporting Limit
- 0.6 - 6
- 6 - 60
- 60 - 600
- 600 - 6,000
- Cobalt Isococentration Contour
- - - Inferred Cobalt Contour
- DAPL Pools
- Paved Road
- Unpaved Road
- Rail
- - - Site Boundary
- Water Features
- Buildings
- Wetlands



1 inch = 800 feet



FIGURE 9C

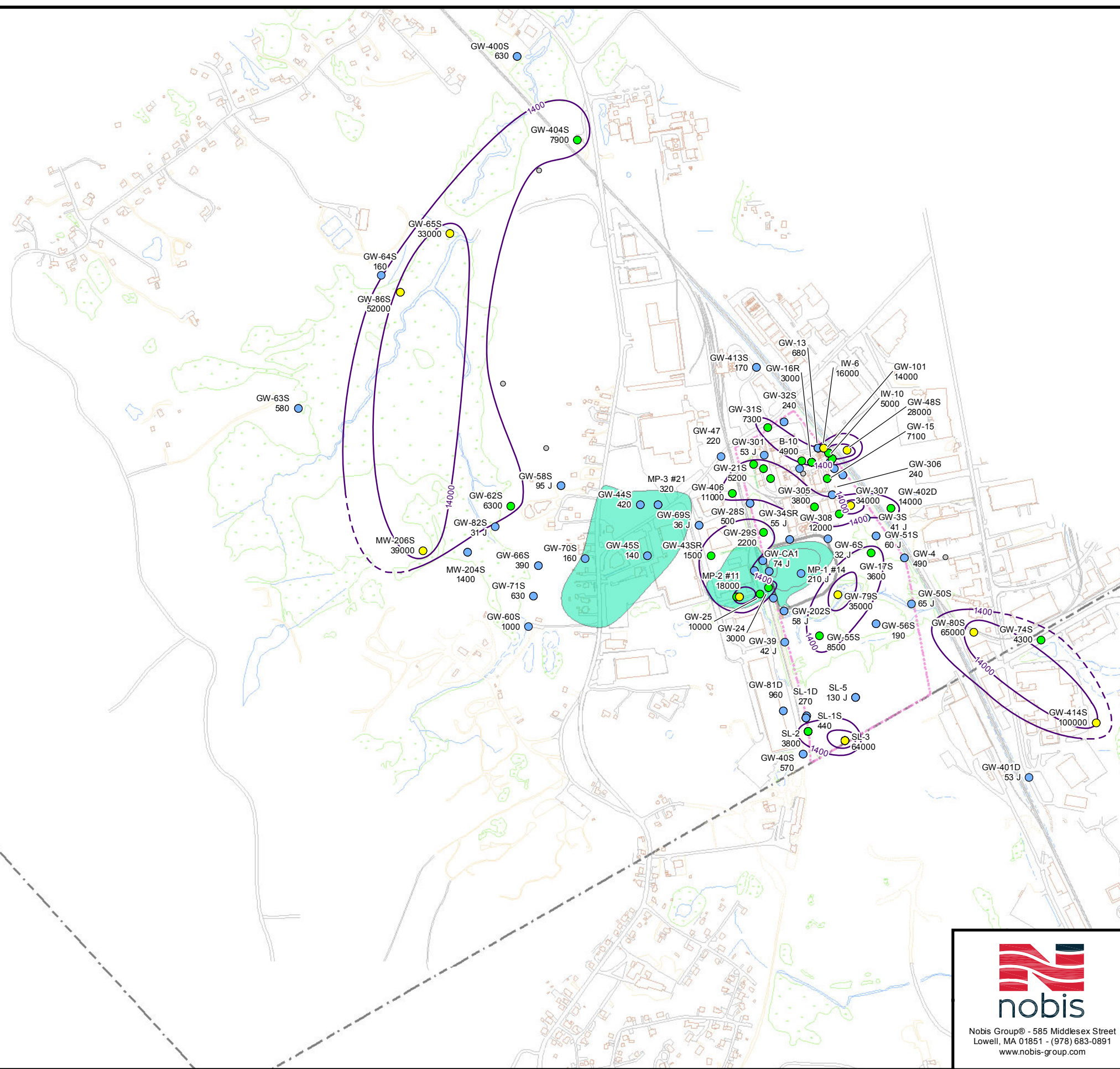
**COBALT IN BEDROCK GROUNDWATER
OLIN CHEMICAL SUPERFUND SITE
WILMINGTON, MASSASHUSETTS**

PREPARED BY: JH
PROJECT NO. 80021

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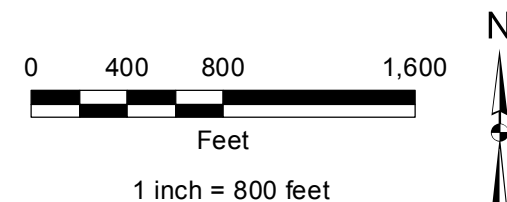
1. Maximum result from 2010-2017 sampling events is labeled.
2. All concentrations shown are in micrograms per liter (ug/L).
3. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

Iron in Shallow Overburden

Tapwater RSL = 1,400 ug/L

- < Reporting Limit
- < 1,400
- 1,400 - 14,000
- 14,000 - 140,000
- Iron Isoconcentration Contour
- - - Inferred Iron Contour
- DAPL Pools
- Paved Road
- Unpaved Road
- Rail
- - - Site Boundary
- Water Features
- Buildings
- Wetlands



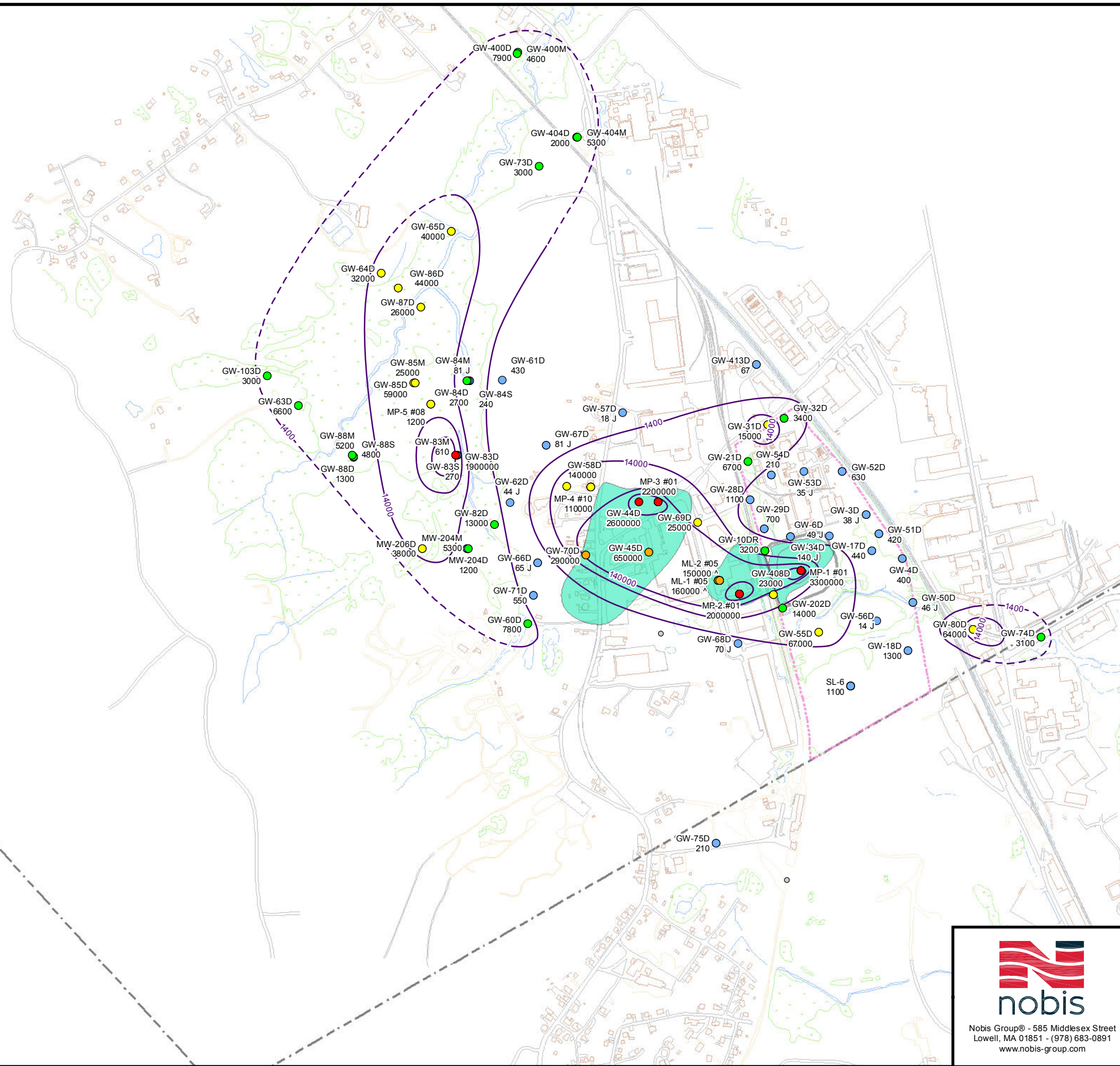

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FIGURE 11A

IRON IN SHALLOW
OVERBURDEN GROUNDWATER
OLIN CHEMICAL SUPERFUND SITE
WILMINGTON, MASSASHUSETTS

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PROJECT NO. 80021	DATE: NOVEMBER 2018

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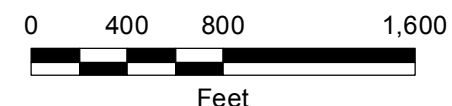
1. Maximum result from 2010-2017 sampling events is labeled.
2. All concentrations shown are in micrograms per liter (ug/L).
3. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

Iron in Deep Overburden

Tapwater RSL = 1,400 ug/L

- < Reporting Limit
- < 1,400
- 1,400 - 14,000
- 14,000 - 140,000
- 140,000 - 1,400,000
- > 1,400,000
- Iron Isoconcentration Contour
- - - Inferred Iron Contour
- DAPL Pools
- Paved Road
- Unpaved Road
- Rail
- - - Site Boundary
- Water Features
- Buildings
- Wetlands



1 inch = 800 feet



FIGURE 11B

**IRON IN DEEP
OVERBURDEN GROUNDWATER
OLIN CHEMICAL SUPERFUND SITE
WILMINGTON, MASSASHUSETTS**

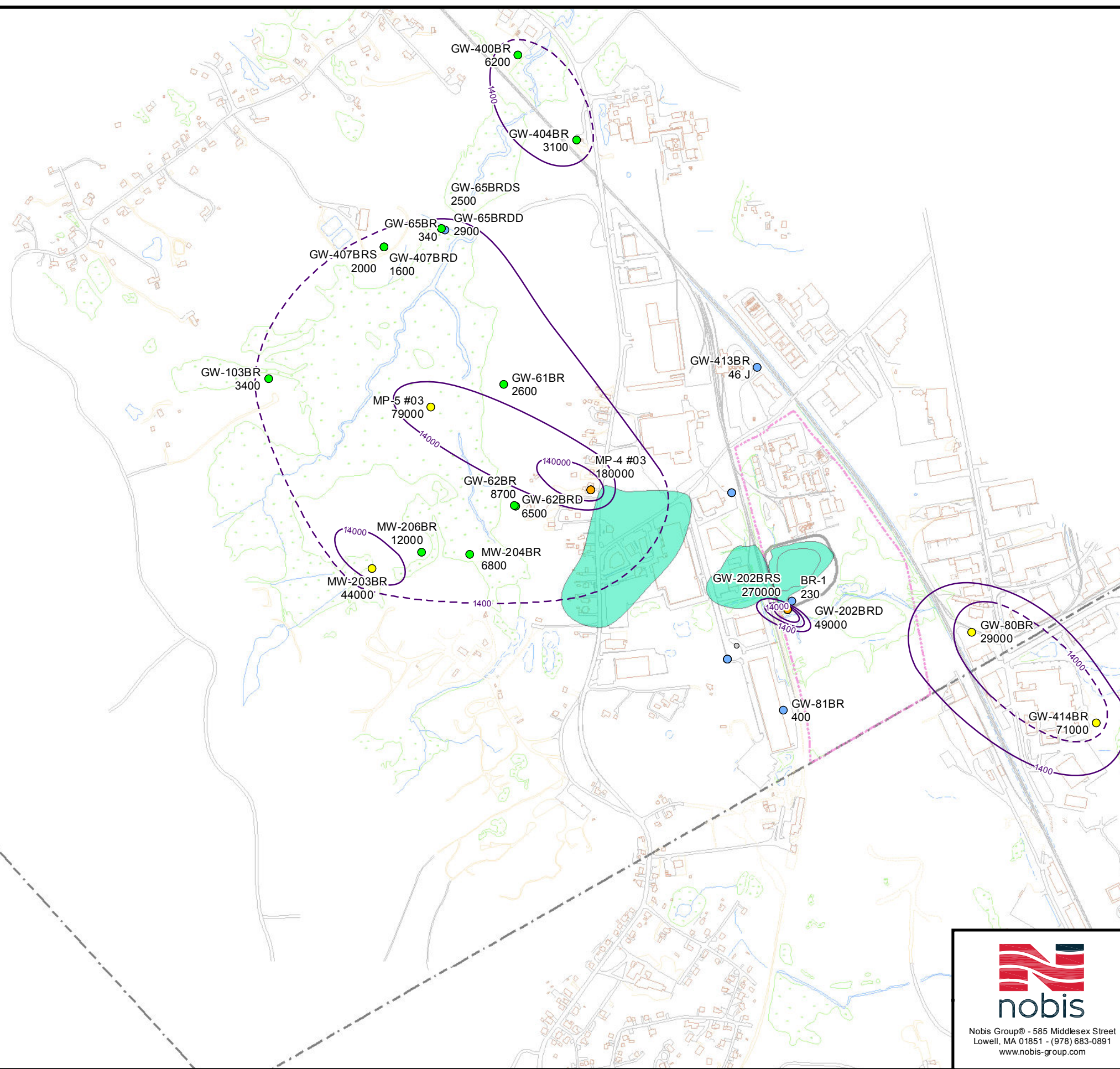
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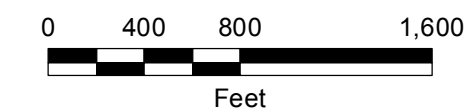
1. Maximum result from 2010-2017 sampling events is labeled.
2. All concentrations shown are in micrograms per liter (ug/L).
3. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

Iron in Bedrock

Tapwater RSL = 1,400 ug/L

- < Reporting Limit
- < 1,400
- 1,400 - 14,000
- 14,000 - 140,000
- 140,000 - 1,400,000
- > 1,400,000
- Iron Isoconcentration Contour
- - - Inferred Iron Contour
- DAPL Pools
- Paved Road
- Unpaved Road
- Rail
- - - Site Boundary
- Water Features
- Buildings
- Wetlands



1 inch = 800 feet



FIGURE 11C

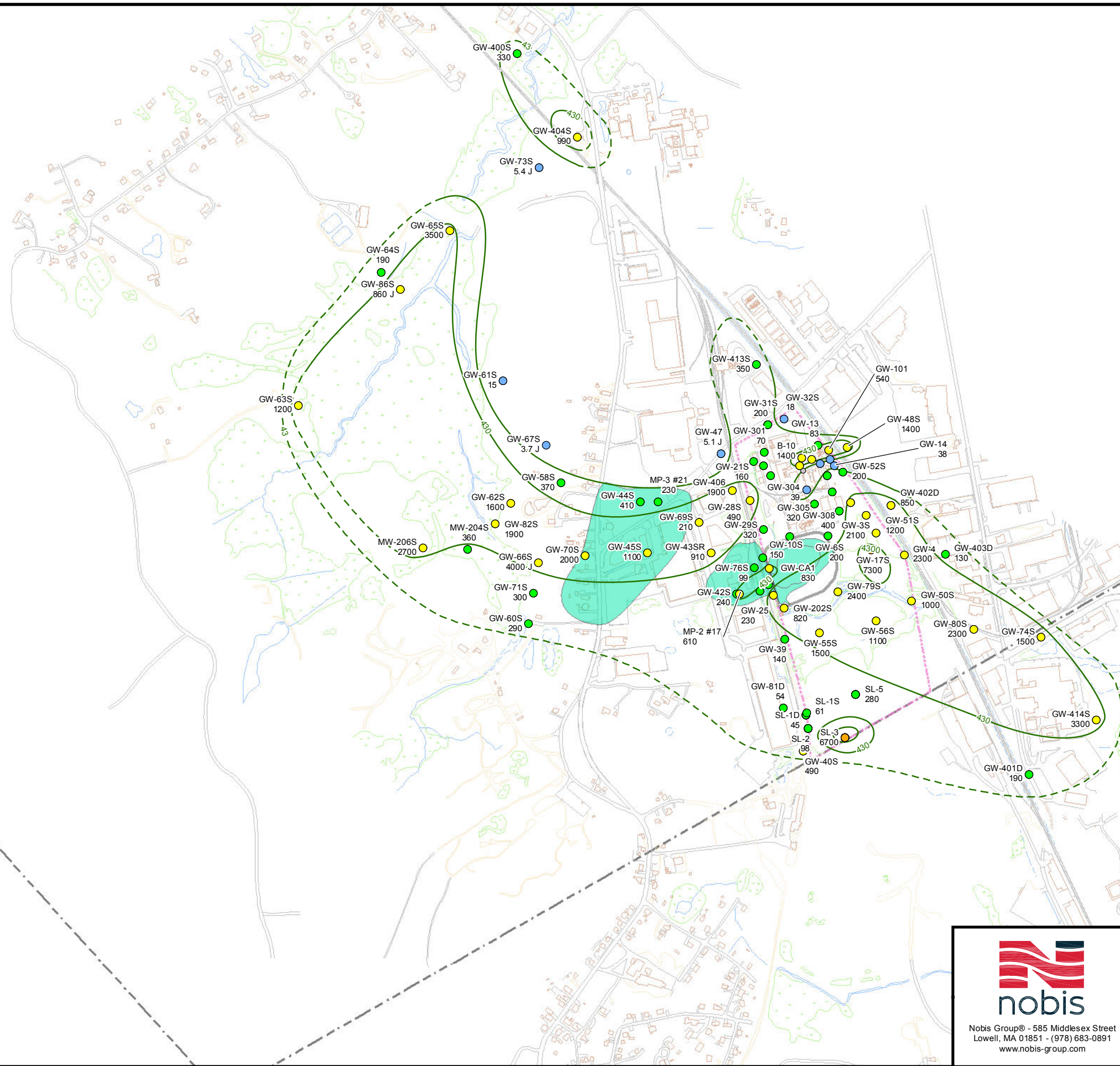
IRON IN BEDROCK GROUNDWATER
OLIN CHEMICAL SUPERFUND SITE
WILMINGTON, MASSASHUSETTS

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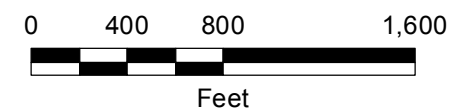
1. Maximum result from 2010-2017 sampling events is labeled.
2. All concentrations shown are in micrograms per liter (ug/L).
3. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

Manganese in Shallow Overburden

Tapwater RSL = 43 ug/L

- < Reporting Limit
- < 43
- 43 - 430
- 430 - 4,300
- 4,300 - 43,000
- Manganese Isoconcentration Contour
- - - Inferred Manganese Contour
- DAPL Pools
- Paved Road
- Unpaved Road
- Rail
- - - Site Boundary
- Water Features
- Buildings
- Wetlands



1 inch = 800 feet



FIGURE 12A

**MANGANESE IN SHALLOW OVERBURDEN GROUNDWATER
OLIN CHEMICAL SUPERFUND SITE
WILMINGTON, MASSASHUSETTS**

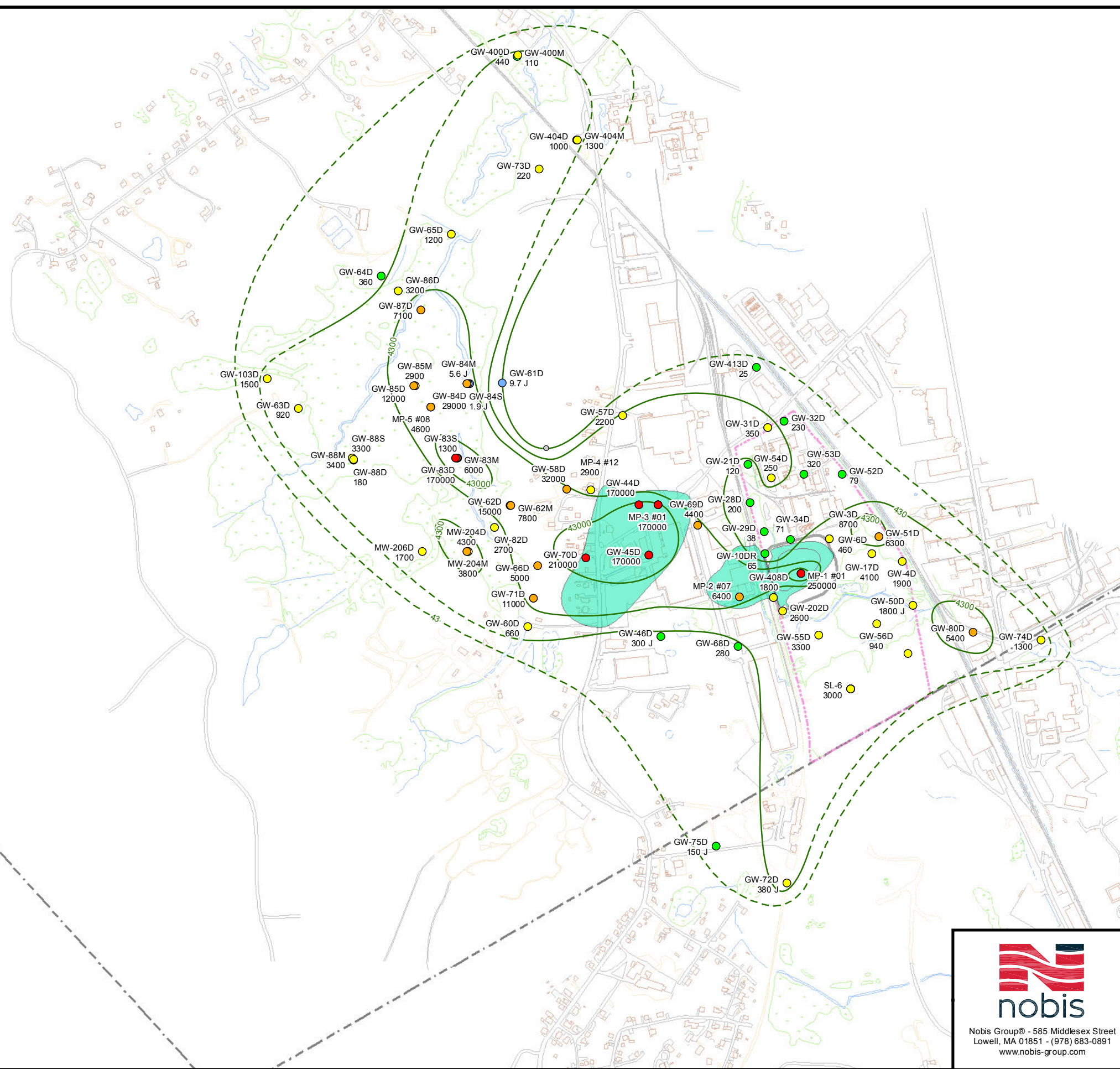
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Notes:

1. Maximum result from 2010-2017 sampling events is labeled.
2. All concentrations shown are in micrograms per liter (ug/L).
3. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

Manganese in Deep Overburden

Tapwater RSL = 43 ug/L

- < Reporting Limit
- < 43
- 43 - 430
- 430 - 4,300
- 4,300 - 43,000
- 43,000 - 430,000

Manganese Isoconcentration Contour

Inferred Manganese Contour

DAPL Pools

Paved Road

Unpaved Road

Rail

Site Boundary

Water Features

Buildings

Wetlands

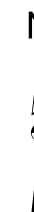
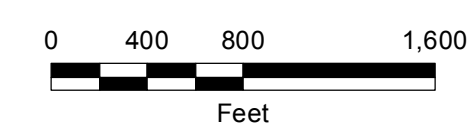


FIGURE 12B

MANGANESE IN DEEP
OVERBURDEN GROUNDWATER
OLIN CHEMICAL SUPERFUND SITE
WILMINGTON, MASSASHUSETTS

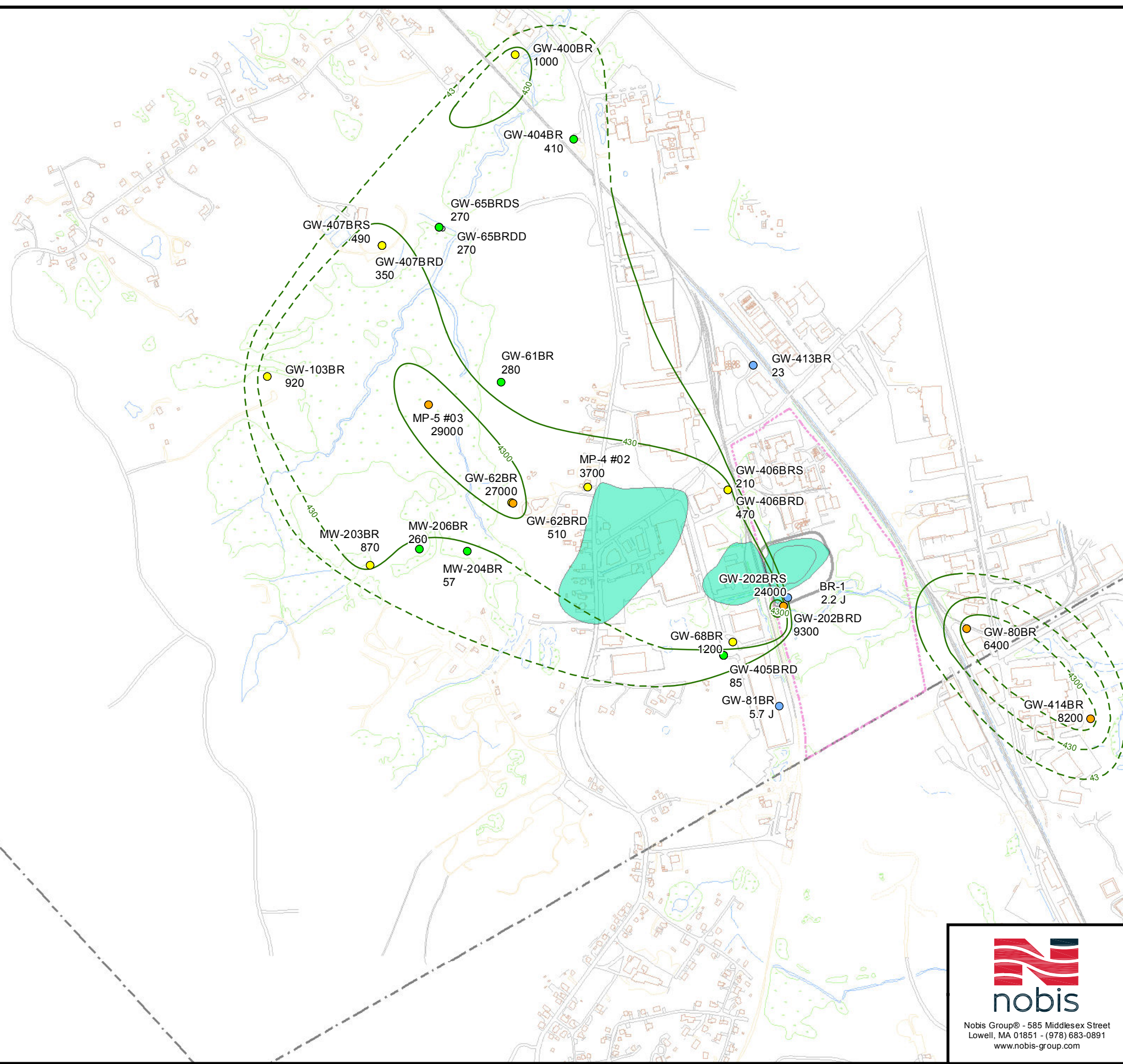
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- Notes:**
1. Maximum result from 2010-2017 sampling events is labeled.
 2. All concentrations shown are in micrograms per liter (ug/L).
 3. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

Manganese in Bedrock

Tapwater RSL = 43 ug/L

- < Reporting Limit
- < 43
- 43 - 430
- 430 - 4,300
- 4,300 - 43,000

— Manganese Isoconcentration Contour

- - - Inferred Manganese Contour

■ DAPL Pools

— Paved Road

— Unpaved Road

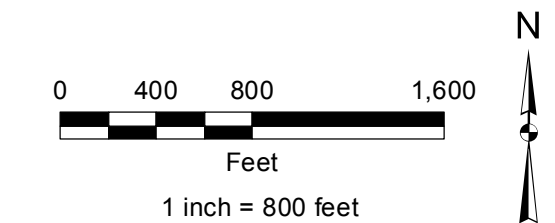
— Rail


- - - Site Boundary

— Water Features

— Buildings

— Wetlands

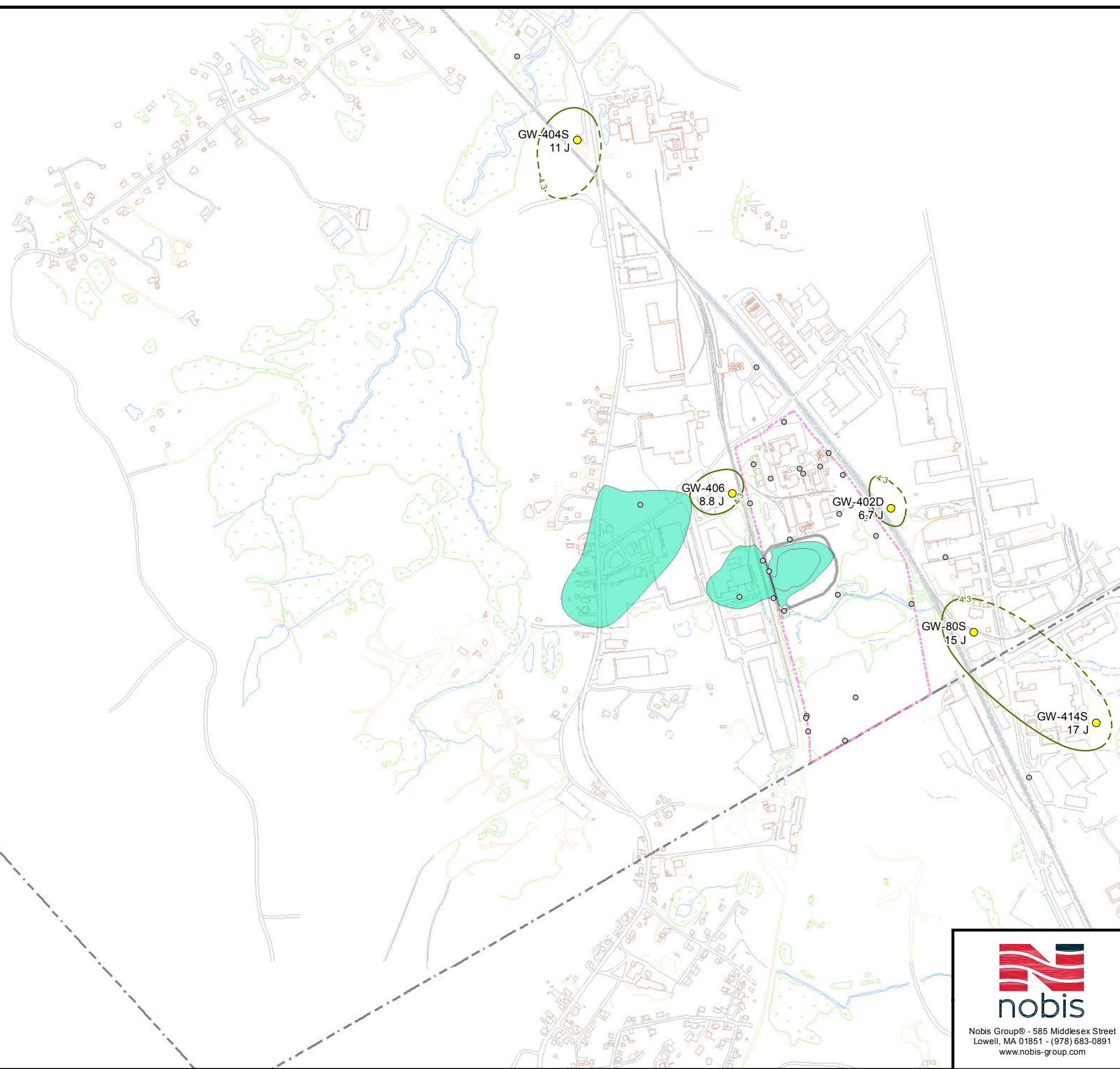




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FIGURE 12C	
MANGANESE IN BEDROCK GROUNDWATER OLIN CHEMICAL SUPERFUND SITE WILMINGTON, MASSASHUSETTS	
PREPARED BY: JH	CHECKED BY: JL
PROJECT NO. 80021	DATE: NOVEMBER 2018

R:\80000 Task Orders\80021 Olin Chemical\Technical Data (TD)\GIS_Data\Maps_Figures\2018 Groundwater\Contaminant Contour Maps\Figure 10 thru 18 Olin 2018 GW Contaminant Contours.mxd 11/19/2018 17:01 jharrington



Notes:

1. Maximum result from 2010-2017 sampling events is labeled.
2. All concentrations shown are in micrograms per liter (ug/L).
3. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

Formaldehyde in Shallow Overburden

Tapwater RSL = 0.43 ug/L

- < Reporting Limit
- 4.3 - 43
- Formaldehyde Isoconcentration Contour
- - - Inferred Formaldehyde Contour
- DAPL Pools
- Paved Road
- Unpaved Road
- Rail
- - - Site Boundary
- Water Features
- Buildings
- Wetlands

0 400 800 1,600
Feet

1 inch = 800 feet

N

FIGURE 17A

**FORMALDEHYDE IN SHALLOW OVERBURDEN GROUNDWATER
OLIN CHEMICAL SUPERFUND SITE
WILMINGTON, MASSASHUSETTS**

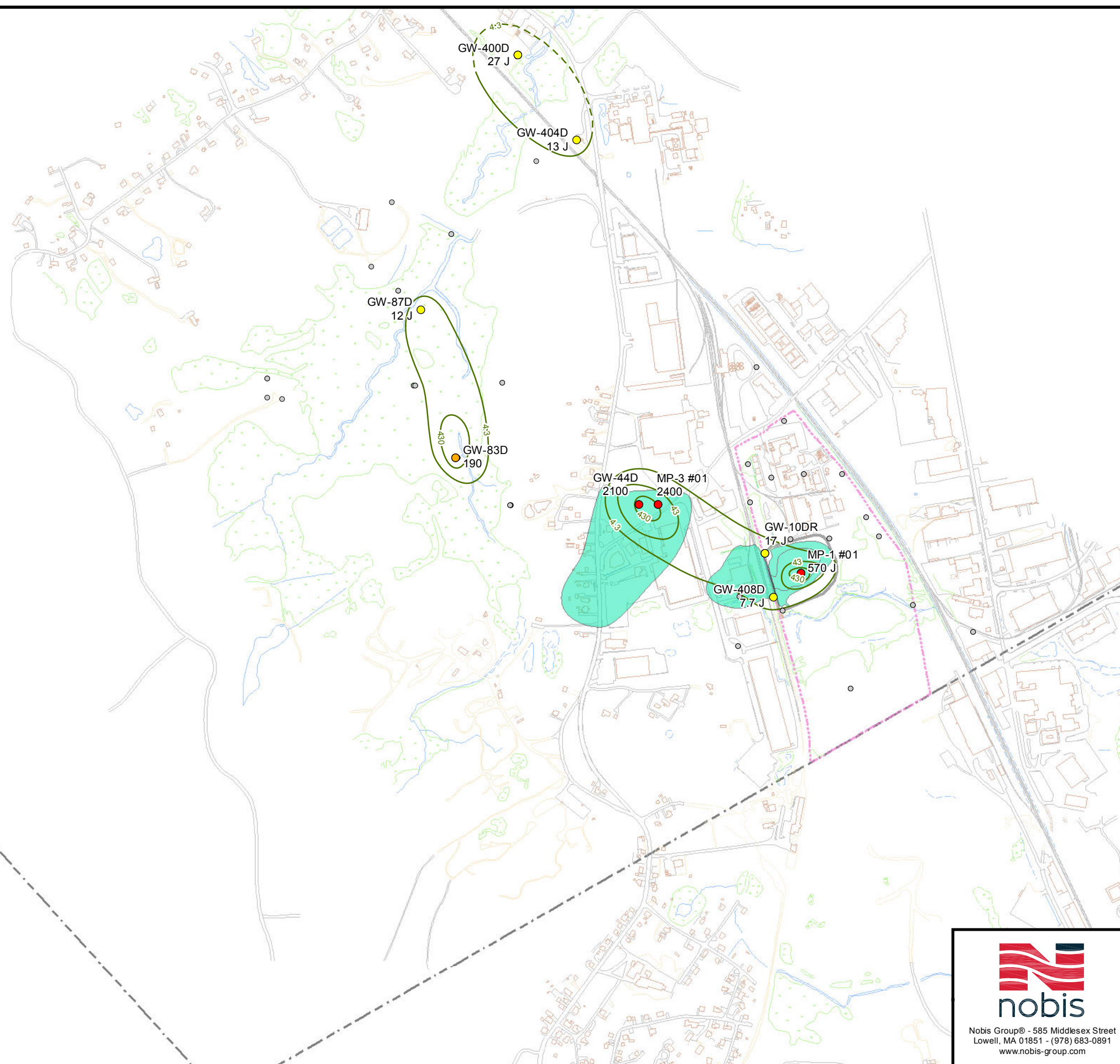
PREPARED BY: JH
PROJECT NO. 80021

CHECKED BY: JL
DATE: NOVEMBER 2018



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Notes:

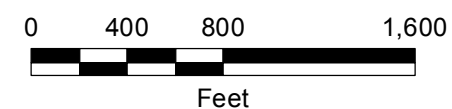
1. Maximum result from 2010-2017 sampling events is labeled.
2. All concentrations shown are in micrograms per liter (ug/L).
3. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

Formaldehyde in Deep Overburden

SMCL = 0.43 ug/L

- < Reporting Limit
- 4.3 - 43
- 43 - 430
- 430 - 4300
- Formaldehyde Isoconcentration Contour
- - - Inferred Formaldehyde Contour
- DAPL Pools
- Paved Road
- - - Unpaved Road
- - - Rail
- - - Site Boundary
- Water Features
- Buildings
- Wetlands



1 inch = 800 feet



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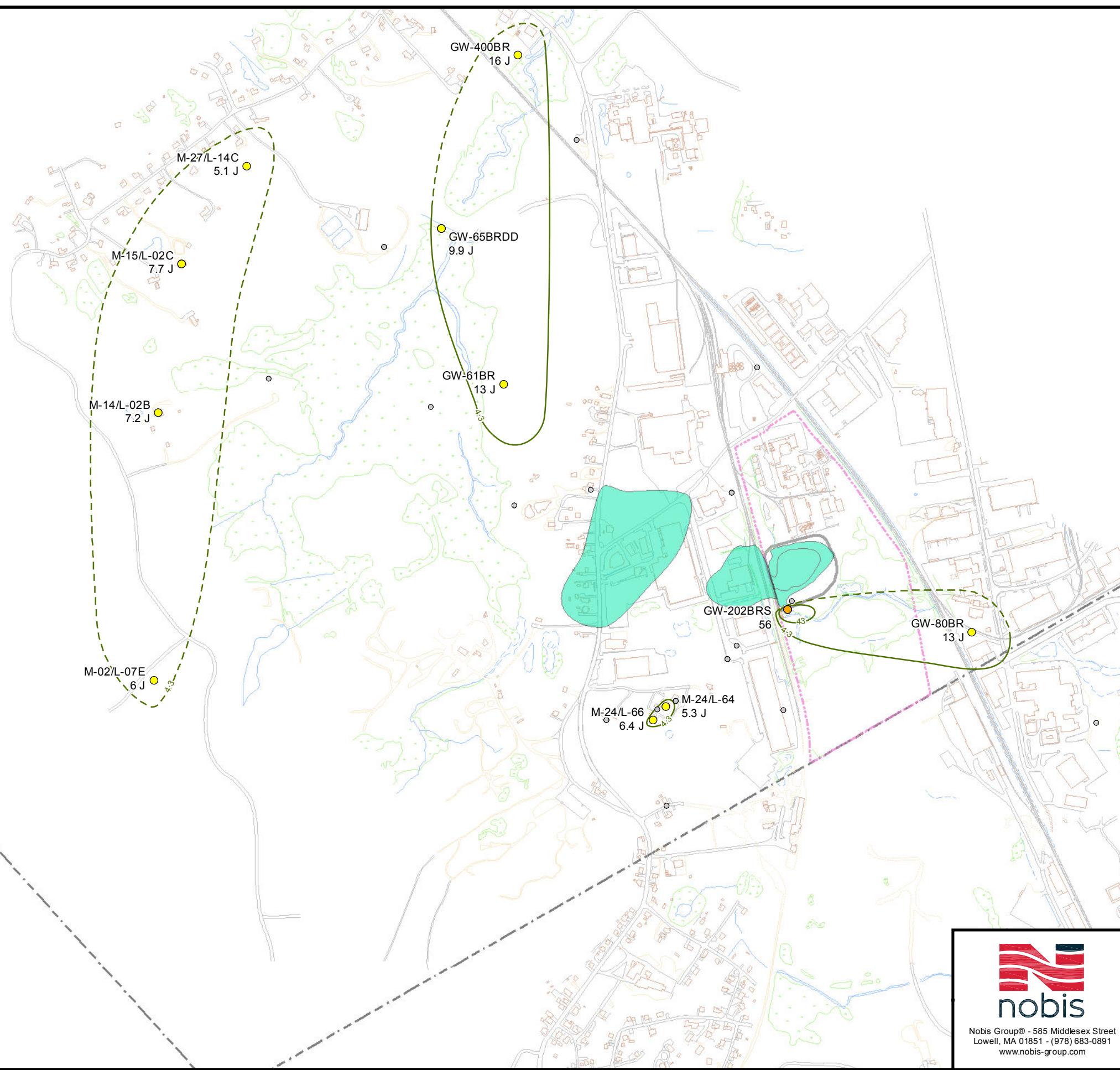
FIGURE 17B

**FORMALDEHYDE IN DEEP OVERBURDEN GROUNDWATER
OLIN CHEMICAL SUPERFUND SITE
WILMINGTON, MASSASHUSETTS**

PREPARED BY: JH
PROJECT NO. 80021

CHECKED BY: JL
DATE: NOVEMBER 2018

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Notes:

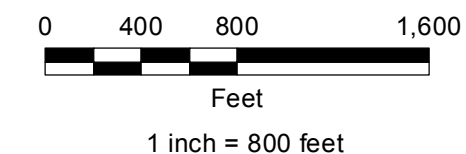
1. Maximum result from 2010-2017 sampling events is labeled.
2. All concentrations shown are in micrograms per liter (ug/L).
3. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

Formaldehyde in Bedrock

Tapwater RSL = 0.43 ug/L

- < Reporting Limit
- 4.3 - 43
- 43 - 430
- Formaldehyde Isoconcentration Contour
- - - Inferred Formaldehyde Contour
- DAPL Pools
- Paved Road
- Unpaved Road
- Rail
- - - Site Boundary
- Water Features
- Buildings
- Wetlands



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FIGURE 17C

**FORMALDEHYDE IN
BEDROCK GROUNDWATER
OLIN CHEMICAL SUPERFUND SITE
WILMINGTON, MASSASHUSETTS**

PREPARED BY: JH
PROJECT NO. 80021

CHECKED BY: JL
DATE: NOVEMBER 2018

ATTACHMENT B – WETLAND PHOTOGRAPHS



Photo 1 – View of MMBW looking south from the GW-65 cluster. Note the stream Channel.



Photo 2 - GW-86 cluster (facing southeast) with top of casings approximately 10 feet above ground surface.

ATTACHMENT B – WETLAND PHOTOGRAPHS



Photo 3 – View of MMBW looking south (towards the island) from the GW-65 cluster.



Photo 4 – View of wetland facing east from WTP property with typical thin vegetation. Main Street is in the background.